Of Seeing

To do justice to ~~the Physiology~~ this sense, would require a whole course of lectures. — The mathematician & natural philosopher has each in his turn made the theory ~~of~~ of Vision the subject of investigation and controversy. [I shall only mention these controversies, and confine myself to that detail of facts & principles which ~~should~~ should be previously known by a student of medicine, before he can understand the pathology of the eye ~~the organ of~~ the sense of seeing. —

This ~~is~~ is important

Insects are possessed of a number of eyes to defend them from the injuries from all quarters to which from this weakness, they are constantly exposed.

Vision is nearly universal. Few animals exist without it. It exists in the highest degree in birds - next in man - then in the ape - in certain quadrupeds, - & descends gradually to reptiles, insects - and fish.

The size of the eye is in an inverse proportion to the size of animals - It is least in the whale the Rhinoceros, & the Elephant, & largest in birds & insects. The eyes are placed in the human body =

of a cat, highly grateful

Sense is committed to two distinct organs, alike in every respect in their structure, and uses. They serve from their number to impart beauty & symmetry to the face, & to prevent the extinction of vision by the loss of either of them. It is remarkable that no animal possesses but one eye or an odd number of eyes. they all have 2. 4. 6. & 8 or more. in the most suitable part of the head in the human species, to perform the office assigned to them. They are lodged in the cavity of a bone to defend them from injuries — and eye brows — eye lids — and eye lashes all concur to

V The Structure of the eye lids, as being the
seat of several diseases merits our parti-
-cular attention. They consist of six coats.
1 The Cuticle which peels off after
receiving from the Erisepelas. 2 The true
Skin. 3 The cellular membrane. This
thin coat sometimes swells in the small pox &
in Erisepelas to the thickness of an inch.
It is sometimes swelled in a Dropsy.
It is remarkable † in the fattest persons
there is never any fat in this membrane.
4 The muscular expansion of the elevator
muscle of the eye. 5 a Stratum of papillæ.
6 a fine membrane which lies next to
the eye - full of small vessels visible upon
elevating the eyelids. By means of these nu-
-merous membranes, the eyelids are
elevated & depressed without any wrinkle
It is remarked

protect the eye from too much light - [illegible]
[illegible] from the sweat which distils from the
brow in labor. [illegible]
[illegible] also from insects - and the par-
=ticles of dust which float at all times
more or less in the air. — They are called by Dr Haller "Tuta-
=mina Oculi." the eye lashes curl upwards at their extre-
=mities.

To facilitate the motions of the eyes, they are provided with a number of muscles which move it in every possible direction, and with a velocity that can scarcely be measured. —

To preserve the softness and transa-
=parency of the eyes, as well as to facilitate their motions, they are provided with glands of different kinds, some of which secrete an unctuous - and others a watery liquor

the Birds which soar in the air as the Eagle &c have a third ~~eyelid~~ eyelid. So ~~have~~ nocturnal birds. Fish have no eye lids. The water in which they swim, washes the rays of light, & serves the purpose of tears.

The use of the Eyelids is demonstrated by the loss of sleep - pain - inflammation - fever & death which follow the loss of them. [Regulus. also the Opthalmia which follows an inability to close them from inflammation & swelling. Only cured by cutting them so as to abate this swelling by bleeding].

which are poured forth at all times in health, at such times, & in such quantities as they are most required. — 377 Fine p. 384

The Coats of the eye ~~[illegible]~~ have been divided into 3 by some, & 5 by other physiologists. According to the latter division they are the Conjunctiva, or Adnata - the Choroidea - the Sclerotica - the Cornea - the Iris - and the Retina. —

1 The Conjunctiva - is a continuation of the cuticle, ~~[illegible]~~ It covers the anterior part of the whole eye, and connects it with the eyelids. It is in a sound state always transparent.

2 The Sclerotica - forms what is called the white of the eye. - It is a dense - compact membrane extending from the optic nerve to the cornea. It has but few blood vessels, and nerves, & has but little sensibility. Some anatomists

suppose it to be a continuation of the Dura mater, but others with more reason suppose it to be a simple membrane accompanied only by the pia mater continued from the optic Nerve. In adults this continuation of the pia mater has never been discovered.

3 The cornea is placed in the middle of the anterior part of the eye. It is supposed to be a continuation of the Sclerotica, but Dr Haller has proved them to be distinct membranes by their spontaneous separation from each other, after being macerated in warm water. It projects beyond the Sclerotica, and thereby assumes a more convex appearance.

~~Different views in different people, but~~

~~it is transparent in every eye~~. Upon close examination it appears to consist of a number of lamella or plates, between each of which there is contained a small quantity of water. It is from the effusion of this water, that the eye loses a small portion of its convexity, immediately after death. The Cornea is said to be destitute of blood vessels, but inflammation evidently discovers them, tho' possibly, they may be branches only of the vessels of the Sclerotica. No Nerves have as yet been discovered in the Cornea, - tho' we often find particles of iron & glass when they penetrate, and adhere to it excite both pain & inflam^{n}:

This membrane or Uvea is covered w. a black pigment. It is paler in old, than in young people. — It is of a light color in the bat - & in many other animals which see best at night. Its dark color was intended to serve the opposite purpose of a mirror. It was not to reflect, but to dissipate rays of light.

4.5 The Choroidea is placed under the Sclero-
-tica, and is connected with it by numerous
intervening vessels. It consists of numerous
small Arteries, and Veins. It accompa-
-nies the Sclerotica to the Cornea where it
adheres to the Sclerotica by means of a
cellular membrane resembling a white
fringe & is called the ciliary Circle.
From this connection, it descends down-
-wards & inwards, forming a round disk
of which the Anterior Surface is called
5 Iris from its variety of Colors, & its
Posterior Uvea - or membrana Ruyschi-
-ana. This disk has an opening in its
middle called the pupil which it is
capable under different circumstances

of contraction & dilatation. ~~The Iris~~
The Iris is said likewise to be capable of similar contraction & dilatation but its is probably passive only - in the contraction & dilatation of the pupil. The fluid which pass from the external margin of the Iris to the pupil ~~are~~ have been supposed to be muscular fibres. - they become straight when the pupil is contracted, & are drawn into serpentine folds when the pupil is dilated. Some late dissections shew the Iris to be flat & not convex &c

6. The Retina is a continuation of the medulla from the optic nerve, ~~which~~ and is ~~which~~ expanded into a spherical concentric with the tunica choroidea. It is extremely tender, and of a mucous consistence. It embraces the vitreous

humor of the eye, and after extending itself to the ciliary processes it follows their course supported by their arteries, until it reaches to the Crystalline lens to which it is intimately connected.

Lect: 14th Decem 27th 1791

The humors of the eye are three viz: the ~~opaque~~ vitrious - the Crystaline - & the ~~clear~~ aqueous. It is most proper to call the Crystaline a Lens. I shall briefly describe them. or 1st The vitrious humor so called from its resemblance to melted glass fills the posterior part of the eye. It is contained in a thin pellucid membrane of a cellular fabric in the intervals of which is contained a clear liquor a little denser than water which entirely evaporates by heat. It is furnished with small blood vessels which pass thro to the

+ Its use is to preserve a due softness in the Retina, and to afford support to the Crystalline Lens. —

V Its sides are softer than its middle or central parts, - from which it has been said improperly to swim in a watery liquor. This peculiarity in the structure of the Lens prevents its use from being completely imitated by Glass in experiments out of the body. For while Glass refracts the rays of light alike on its sides & center, the Lens of the eye refracts them less on its sides, than its centre, and hence it throws the image further - as to bring it to a focus on the retina. —

Crystalline Lens. +

2ly In the forepart of this Vitrious humor, appears the Crystalline Lens is sea-
=ted, behind the Uvea in an orbicular Sinus. This Lens is more convex in its posterior, than in its Anterior part. It is composed of concentric plates or Scales, connected by cellular fibres. Betwixt these plates is contained a pellucid liquor. The innermost plates of the Lens adhere closest together. The artery, comes from the retina thro' the Vitrious humor. The whole Lens is contained in a Strong - thick - elastic capsule - Of a pellucid membrane - firm on the forepart, and lined behind by the

It is somewhat thicker in its consistence than water, & especially frozen. It is somewhat brackish to the taste, and may be congealed with Spirit of wine. I have seen it converted into a white mass by the application of a strong solution of Sugar of Lead to the eye in an Ophthalmia. It often assumes a white appearance in old people, also in consumptive patients. Its use is, to preserve the pellucidity of the Cornea. Hence we find it present in that coat of the eye, also to defend the Lens & Iris from injuries, & to allow the Iris a space to play in. — The external

membrane of the Vitrious humour.

3 The Aqueous humour is extremely clear and fluid. It is seated between the Uvea & Chrystalline Lens, & in the ~~cavity~~ chamber which lies between the iris and Cornea. It exhales from the small arteries of the iris, Uvea, & ciliary processes. When discharged in couching, or by a Wound it is frequently renewed in the Space of 24 hours.

4 Having thus briefly described the Structure of the eye, I should proceed to explain the Nature of Vision, but I shall previously say a few words first upon the Nature of Light,

go on to p: 377

~~as far as~~ as exit connected with our subject.

Surface of the eye is moistned by a fluid called tears which are constantly secreted & poured out from the Lycrymal Gland thro 7. or 8 Ducts which open in the inside of the upper eye lid. The rapid evaporation of this fluid in hot Countries occasions the most distressing Opthalmias - A Defect of its evaporation which takes place in wet weather occasions involuntary tears. — They become acrid by an inflam: - of the eyes. What is not required to moisten the eyes nor in weeping is absorbed by the puncta lacrymalia, & conveyed into the Lacrymal Sac from whence they pass thro the nasal canal into the nose.

turn back to 362 r

~~Therefore is~~ I believe light to consist of Matter, and that it pervades every part of our Solar System. ~~It appears to~~ It is invisible in the night only because it is in a quiescent state. Motion is essential to its producing vision - and

seal broken 1/21/1972

pp 360-376

to be com

rays of the Sun. It is necessary to stagger our faith, or to fatigue our imaginations by supposing that these solar rays travel thirty millions of leagues every morning ~~twenty~~ per 7, or eight minutes, or four millions of leagues in a minute, in order to illuminate our globe. By no means, I would rather suppose that they act by imparting motion

or matter
to the particles of light which already
exist in the air. — In explaining
muscular motion I supposed the
brain to be the origin of all motion,
influence, but I did not admit y^e
nessity of an influx from the
brain in every act of muscular
volition. I supposed the nerves of
the nerves in the extremity of the body
which was the vehicle of motion only
to be moved by a motion began in the
brain, and that the matter which
conveyed these motions was stationary
in every part of the nervous system.
In like manner may we not sup-
pose the soul to with respect to

light to be a kind of brain of our
Solar System, and that it acts only
by imparting motion to those rays
which are connected with its substance,
which rays by a law of motion for-
-merly mentioned communicate it,
perhaps in less than 7 or 8 minutes,
probably
- in the twinkling of an eye to ~~every~~
~~part of~~ our globe. ~~In this~~ But further,
during the repose of the brain, - sensation
& motion are every where ~~is suspended~~ they matter & properties
on which they depend, still exist
- but it ~~is still exists~~
in the extremities of the muscular
fibres. ~~Like the particles of light they~~
~~are only in a process~~ So like man-
-ner, during the absence (or as an
Indian would express it) during the

repose of the sun, the particles of light or matter which are diffused over the surface of the globe, & probably this all our solar system are suspended in their operation. – They are deprived of motion, but they still exist, and wait only for the return or fresh excitement of the sun to restore to them the properties of motion and light. – As certain stimuli restore the sensation & motion in the extremities during the repose of the brain, so certain artificial lights such as fire-Lamps – and candles by exciting motion in the particles of light, supply the absence within a certain space, of the great sensorium of day. –

It would be easy to go on & multiply
analogies of the resemblance ~~of light~~ be-
tween the manner in which it is possible for light and
muscular motion ~~may~~ to be produced.
The Author of Nature seems to have
created all things as it were by a
single instrument, and the further
we push our inquiries into the Natural
- the moral - & the intellectual worlds,
the more we observe the operations
in each of them to be carried on by
the same simple principles. Eg: the
absence of light is darkness in the natu-
ral - the absence of good is evil in the
moral - and the absence of knowledge
is ignorance in the intellectual world.

† Exodus 25. 9. 40. & Numbers 8. 4

Here we observe three great effects to be produced in the same simple manner. ~~all the works of the Creator are full~~ of similar examples of Unity, and simplicity appear in all the works of the great Creator. — He seems in the ~~Heavens~~ work of Creation to have delighted in precedents, or in following his own sublime & original examples of perfection. He created the first man - after his own image. - and he furnished Moses on the mount with a pattern of all the furniture of the tabernacle and the altar which he afterwards built in the wilderness.

But my theory of light is far from being simply conjectural, or founded

only on the analogy of the functions of the ~~nerves~~ Brain - and other parts of the nervous system. - In the ~~account~~ Acct. of the Creation given by Moses, we find light was formed - before ~~it was made~~ the Sun, and that it was by means of the Sun that the relative terms of day and night were introduced. - I say relative terms - for there is no such thing as absolute darkness, ~~but~~ except here that ~~darkness~~ supernatural darkness which was inflicted upon Egypt and which was perceptable to the sense of touch. ~~to have been~~ of, for we read Exodus x 21 that it was darkness that could be felt.

That light is relative I prove from its existing ~~at a~~ during the absence of the Sun. hence we find that certain animals see as perfectly during the night as we do at noon day. We are as yet ignorant of the lowest limits of light as we are of the lowest degrees of heat —, for what is call Cold, is only a diminution ~~of~~ of heat, just as what I called darkness was only a diminution of light. — Allow me another Analogy. ~~It~~ Darkness is light in a latent state. It is converted into sensible light by a sudden impulse from the Sun. — ~~I am the~~ Light then you see Gent: according to my theory depends upon the same

simple cause as animal life viz stimulus and motion. They appear to be ~~the active two great agents~~ the two most active principles in the Universe. —

But from whence do we derive the relative light of midnight – if light be produced only by an impulse from the ~~the light~~ Sun upon certain particles of light. – ~~I answer from the sun and Moon~~ I answer, from the moon & fixed stars, and in the northern Regions from the Aurora Borealis which is seldom absent during the long nights of ~~this~~ those northern Countries. Perhaps too sometimes analogous to sensation takes place in the matter of light.

rays of

V. Why does not the light which enters a dark room by a key hole fill it with light? — It only produces light on those particles of the matter of light which lie in its way. —

when a Stick on fire is turned round with a quick hand, it produces in the ~~eye~~ eye ~~Incod~~ a Sensation of a fiery circle. This is occasioned by the sensation being continued a short time after the impression has ceased to act upon the Optic Nerve. In like manner ~~a~~ minutes. & even half an hour. It continues in other instances may not a small degree of Sensation be left in the matter of light after the Sun has ceased to act upon it.

~~my~~ The doctrine which I have offered to you does not militate in the least against the ~~old opinion of the~~ Sun being a great body of light- or the ~~only~~ great Source of light.

I believe it to be both, but that it produces light in our globe - not by ~~sleep~~ sending an ocean of particles to us every day, but simply by setting these particles in motion ~~as~~ with in the Insides of our globe & perhaps our whole planetary system is filled. —

Does not the feeble and partial light which is produced by artificial means during the absence of repose of the brain answer to the sensations & motions which are excited in the nerves & muscles during the ~~repose~~ suspension of the ~~brain~~ powers of the brain in sleep and in diseases, as well as to the sensations & motions which are produced in those animals which are devoid of brains.[2] Does it not show something like a vis insita in the particles or

v If this account of the production of light be admitted, it will relieve us from all the ~~difficulties~~ controversy about the diminution of the Sun by shining. There will be no more occasion to suppose that it ~~is~~ is spared by ~~this~~ producing light that than the brain is spared in its lose on ~~from~~ weight by producing sensation ~~or~~ & motion in the extremities of the body.

matter of light ? — V

~~There is nothing in~~ this theory will receive some support from attending to the history of Sounds. ~~The body which~~ Sound as I shall say hereafter is produced by vibrations or undulations communicated to the air by an impulse given to a sonorous body. — Nothing is emitted or discharged from this body. It does not change its place. Its tremblo only, — and its tremors move successive ly contiguous particles of air as far as ~~its~~ these tremors extend. Who ever supposed the last particle of air that was moved came from the sonorous body? — Why then should we suppose the

V They must all three be resolved into an
Arch institution of the Deity.

matter of light to come every morning to the Sun? It is sufficient for our purpose if the Sun give the same motion to the matter of light which a sonorous body gives to distant particles of air. —

Do you ask, how motion creates light? I shall answer it by asking two other questions. How does the brain produce sensation & motion in matter? and how do certain tremors in the air produce Sound?

Do you ask how light is altered in its direction as I shall say presently in passing thro a dense medium such as water or glass? I answer — just as is Sound altered in

You see then that I consider light - like life - as a quality, only, produced like life by a stimulus acting upon a peculiar kind of Matter. - The Sun with respect to the matter of light seems to occupy the same rank as a primary Stimulus, that dephlogisticated Air does in producing Animal life.

its course by the form of the mediums thro' which it passes.

Do you ask how are the particles of light reflected from shining bodies – I answer just as sounds are reflected from solid bodies when they pro=duce an echo. —

But it is time to quit this subject. Perhaps I have only exposed my temerity in delivering these opinions upon it – for in so doing I have ventured to oppose a part of Sir Isaac Newton's theory of light. – You will pardon me if I am mistaken, especially when you reflect that the doctrine I have advanced is calculated to enlarge our ideas of the important uses of the Science of Physiology,

V The

by shewing us that it may be made
a key to unlock some of the most abstruse
mysteries of Nature] —

Of [illegible] fine as this
matter of light is — it has ever escaped
an Analysis. — Sir Isaac Newton [illegible]
[illegible] as by means of a prism that
has taught us it consists of seven
different species of matter, each of which
is capable under peculiar circumstances
of exciting in the mind seven diffe-
-rent ideas of what is called Color.

These Colors are Red — orange — yellow —
green — Blue — Indigo — and violet. — They may easily
be remembered by taking the initial letter of
each color invented, and throwing them
into a word. — This word will be Vibgyor.

all the Variety of Colors in
Nature & Art are produced by different combinations
of the seven primitive or original Colors
which have been mentioned. The difference
in the Color of any body depends
upon its peculiarity of Structure by which
it is disposed to reflect one set of rays rather
than another. You see here that I consider
Color as a Quality of Matter. The
Sensation of it only exists only
in the mind,
but if there were no vision
and no being; the Substances which reflect all the
different Colors would still have a material existence. The
contrary of this Opinion was held by Bishop Berkley &
who
especially by those who favored

a body is called red when it reflects red rays only - it is called blue, when it reflects blue rays only - and so on of all the other colors. - A body is said to be white - when it reflects all the seven species of rays at once - and black when it absorbs or extinguishes them all. A body which allows all the rays to pass thro' it is said to be transparent & a body which extinguishes one part, and reflects the other is said to be opaque. ✓ go to 383 Dark side -

When the Rays of light strike a body without entering it they are said to be reflected - They strike bodies in different directions, but there is a perfect uniformity in this manner of reflection.

absurdly
~~For~~ supposed that the Matter which existed
~~of~~ all our Sensations had no real positive
or Shape, but existed only in our minds.
The Sugar - a rose - and ~~the~~ the blue color
of the Sky, to have as much a real ex-
istance as the human body, or a Spirit.
It is true the Sweetness of Sugar - the fragrance
of the rose - and the loveliness of the blue
expanse of heaven, are all relative terms
~~they could not~~ but no existance had there
been no animated bodies to ~~a~~ in whose
senses they could have excited the sensations
which I have ascribed to them. They supposed
a capacity only of exciting pleasure & existence and
and ~~require~~ the concurrence of bodily senses to render
them known, but they would have existed with the
capacity of creating those sensations if a human
body had never existed to enjoy them. A house
would have been a house to the end of time,

Hence it has been repeatedly demon-
-strated that the angle of their reflection is
always equal to their angle of incidence,
or in other words, to the angle they make
in falling upon the body from
which they are reflected. —

Again - When the Rays of light are
altered or
broken in their passage thro' a body, they
are said to be refracted. — This refraction
appears when the rays enter this body obliquely but
different according as the rays
pass from a thin into a Dense medium,
or from a dense into a thin medium.
E.g: When they pass from air into Water,
they are refracted towards a perpendicular
drawn in this water to the point of its pen-
-etration where the light falls, - but when they

although it had never been inhabited, and a Gun would have been an instrument of Death. although it never had been employed in taking away the life of a single animal. This gross error of D^r Berkleys is the natural Offspring of a belief in animal life originating in an impulse given to the body by the Soul or mind, for if the mind be capable of beginning life, or bodily existence, no wonder a power is given to it of Annihilating all bodily, or material existences, and occupying alone all the existence in form and Qualities upon our globe.

pass from water into air, they are a
refracted in a contrary direction to the
perpendicular drawn in the air thro' wh.
it passes. - go on to X below

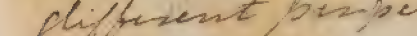
To when I speak of Rays passing thro' bodies &c. I conform to the common language of describing the laws of light, but I beg to be understood here that I mean no more than motion communicated to the matter of light which previously existed upon the surfaces from which it is reflected, or in the Medium thro which it passes with, or without refraction. turn over to 381. A

X The Rays of Light pass thro' mediums of the same quality differently according

to this form. They are further

separated in
different perpendiculars or directions accor-
-ding as the Medium thro' which they pass

thro
is Concave, or Convex. — and

meet sooner in a point, or diverge further

from a point, according to the greater or
lefs concavity or convexity of thro'

this which they pass.

Medium

A Thus I have I delivered you a few gene-
-ral propositions upon the subject of

& Colors,  and the laws of light.
They will be made more plain, and
intelligible to you by experiments &
diagrams by the Professor of N: Philosophy.
I have said no more upon them
nature
than was necessary to explain the


of Vision. —

The application of these facts to Vision will now appear simple to you. The rays of light fall at all times during the day, in various directions upon the Cornea of the eye. Some of them are reflected back from it — viz: all such as fall on the membranes in a greater angle than 40°. — Those which enter the Cornea, undergo a small refraction in the Aqueous humor. — They undergo a still greater refraction in the Crystalline lens — and vitrious humor, and finally they meet in a point or focus upon a small part of the Retina where they paint an image of the Object from which the rays of light are reflected, and which is the Object of Vision. All those rays which the humors of the eye could not concentrate, or refract into a

focus upon the retina are suffocated or lost in the black paint which lies upon the uvea, & the ciliary processes. —

I have said that the Retina is the point in which the visual rays meet in a focus so as produce vision. I am aware however that Mariotte, Le Cat and some other Physiologists place vision in the Tunica Choroidea. The principal argument in favor of this opinion is, that the Spot where the optic nerve enters the retina has no vision, and that on that Spot, there is a defect of the coat of Choroidea. But this proves nothing. The Retina we know is a most sensible nervous medulla, whereas the Choroides possess but few nerves. The Retina

V where the Optic nerve enters it, we find the nerve enters, not in a line with its Axis, but near the Nose, by which means the picture of no Object can fall at the same time on both those insensible parts.

An exact Shape in the humors of the eye is necessary to produce just Vision. If they become too flat, the rays of light are brought to a focus beyond the retina, but if the humors become too convex, the rays are brought to a focus before they reach the retina. In both cases Vision becomes indistinct. Old men are subject to the former disease of the eye. Children are all born subject to the latter, but it goes off as the eye flattens: which it does as they advance in life. Many adult persons are subject to it. They are called Myopes. They relieve themselves by holding the Object of Vision near to the eye, or by concave glasses which prevent the rays of light from meeting in a focus before they

moreover in all animals is as uniform in its shape and properties as Vision itself whereas there is a great Variety in the form of the Choroides in different Animals. Last ~~by~~ any inconvenience would follow from the insensibility of the ~~O~~ Retina at the spot

~~O~~ the Eye possesses a power of accommodating itself to near and distant Objects of vision.

This has been supposed to be effected by the projection, or retraction of the Crystaline Lens, but more accurate Observations prove that the Lens ~~does not move~~ is immoveably ~~out of its~~ fixed ~~in~~ with respect to a forward, or backward motion, and that the ~~pupil~~ Iris only is contracted and dilated according to the distance of Objects. It is contracted in viewing near ~~expands~~ dilatation & contract Objects, and vice versa. ——— This motion in the pupil is produced by the ~~Iris of the~~ elongation

reach the retina. The persons who have flat humors are called Presbyopes. They relieve themselves by ~~the~~ placing the object at a greater distance, or by ~~[illegible]~~ convex glasses, which bring the rays of light w:th them to a focus before the object of vision on ~~[illegible]~~ they pass the retina. + It is remarkable only [illegible] which

The Nyctalopes see to in the dark only. Vol. ta 385

+ This is true in the ordinary state of the eye, but Dr Monroe mentions two cases of internal dropsy of the brain in which the eye contracted with darkness, & expanded with light.

~~[illegible] of the Iris being straight, or being drawn into folds in the manner formerly mentioned.~~ 386-1

The pupil moreover contracts & expands in proportion to the degree of light thro' which it views all Objects. — ~~It~~ It contracts when we go suddenly into an illuminated room, and it expands when we leave such a room and go into a dark place. The greater the darkness, the greater the expansion of the pupil.† The light which is necessary for the purposes of life is not only relative in different animals, but likewise in man-hence we ~~find~~ read of persons who have been gradually able to see, and even to read distinctly in dungeons where at first they were unable to distinguish the largest objects around them. The sudden

V

That vision is most perfect in which we we are able to read a book placed at the distance of one foot from the eyes. —

There is another peculiarity in Vision which deserves our notice. Some ones who possess an apparently perfect eye, are unable to distinguish any, and some but a part of the seven primitive colors. A Student in the College of Glasgow could not discover his red gown, when laid upon the green grass. Mr Dalton in the 5th Volume of the Manchester Memoirs ascribes this peculiarity in Vision to the Vitrious humor being Coloured, so as to Absorb some rays, and transmit others. I would rather suppose it was occasioned by a

Disease in a portion or filament of the nerve which commonly transmits the rays that could not be seen.

Different Colors are induced by closing & rubbing the eyes. This Depends upon the same parts of the retina being stimulated which had been in the habit of producing the ~~same~~ perception of those Colors.

Squinting is occasioned by a weakness of the muscles which move the eyes, or eye. It is sometimes induced ~~often~~ by viewing Objects sideways. This was the case with the Revd. Mr Whitefield. His mother when he was a child placed a black patch to cover a little sore upon the side of his nose. By banishing one of his ~~his~~ eyes in the direction of that patch

he [illegible] lost an equable power over its muscles, and ever afterwards squinted with it. He was called by his enemies from this peculiarity in his Vision Dr Squintum. Squinting is likewise induced by bringing Objects too near the eyes, and by confining Vision exclusively to one eye and thus preventing the habit of Association in the Actions of both eyes.

The eye possesses a power of accommodating itself to near and distant Objects of Vision. This has been supposed to be effected by the projection, or retraction of the Crystalline Lens, but more accurate Observations prove

that the lens is immoveably fixed with respect to it forward or backward motion, and that the pupil only is contracted and dilated according to the distance of Objects. It is contracted in viewing near Objects, and dilated in viewing such as are distant. This motion in the pupil is produced by the Strice of the Iris ~~being~~ running straight, or being drawn into folds in the manner formerly mentioned.

Hydrocephalus in tissues in which the eye contracted with darkness, and expanded with light. The case of the dame kind sent from another canst was once communicated to me by Dr Southey. But against

‡ There is another peculiarity in vision which deserves our notice. Some men who possess a perfect perception are unable to distinguish any of its Colors. Others only a part of the 7 primitive Colors. A student of Glasgow could not discover 10 Colors. In this kind the papiens discover them.

V In this kind the [illegible]ches by the contraction and dilatation of the pupil. —

This red gown when laid on the green grass, exactly by accident. was Dalton in the 5th Vol. of the manchester memoirs ascribes it to the Vitreous humor being Colored, so as to absorb some rays & transmit others. Although taken supposing it was owing to a Diseased of the portion or filament of nerve which [illegible] commonly [illegible] Question is occasioned by such a weakness ‡

impression of light after being long deprived of it, and the sudden abstraction of light, are both equally unfriendly to the healthy exercise of Vision. It is for this reason probably that the light of the morning, and the darkness of night are let in upon us in a manner so gradual as to give no pain to the eye, & never to injure Vision.

All these motions of the Iris & pupil appear to be instinctive in the human Species. But they are under the command of the will in some animals - particularly in the parrot.

These Motions of the pupils are important in certain diseases as they shew the state of the

which is more — or from viewing objects

= in the muscles of the eyes, as ~~that they those~~ in a side direction - Mr Whitefield - or bringing objects too ~~of both eyes do not act in concert~~. It is often near the eyes - Mrs Young's Daughter - cured by convex glasses + confined to one eye - from its not being sufficiently used in concert with its ~~ef~~ fellow eye. - Return to p 384

~~Infants ~~a~~ possess for some weeks a power of moving their eyes only to the right and left. ~~They ...~~ but they are unable to look upwards. ~~The~~ first direction of their eyes is generally towards the light.~~

I formerly spoke of the sympathy between the eyes & the stomach. It discovers this sympathy ~~...~~ in the action of ~~...~~ of Opium upon Vision. It produces delight-ful or ghastly images according to the Dose that has been taken.

Children seldom see correctly until 3 weeks or a month after birth owing to the greater thickness of the Cornea, & a less quantity of aqueous humour in the eye than is proper for vision. The Cornea measures 1 line in a new born infant, & but $\frac{1}{8}$ of a line in a grown person. For some weeks after birth it can only move its eyes to the right and left. It is unable to look upwards. ~~...~~ Its eyes are first attracted by light.

Retina and Brain with respect to sensibi-
-lity and oppression. They moreover
this certain weakness in the
System hence it is generally dilated in Chronic diseases particularly the presence of
Phthisis pulmonalis preceding to Dr Withering

It is remarkable that grey or blue
eyes are most common in northern,
& black or dark coloured eyes most
common in Southern Countries. A
wise reason may be given for this
difference of color in the eye. The blue
& grey eye is most accommodated
to the scanty light of a northern, &
the black eye to the redundant rays
of a Southern sky. — Were it otherwise,
imperfect vision or blindness

would be more universal from the feeble impression of light in the former, & the too powerful impression of it in the latter case. The Indians who inhabit the middle & northern regions of the United States are the only exception that I know to this remark. They have in general black eyes, altho' they live in a northern country. But I suspect they are not the aborigines of the latitudes they now occupy. They appear to have wandered Along the shores of the Mesipisi from South America. — The remark therefore will stand good Untill we are informed that the Esquimaux Indians, and the nations to the North of them have eyes of the same color with the Indians who

live in the middle regions of North America. — I respect that it will be found that they have the grey, or blue eye of all other northern nations. —

It is a curious fact that all objects are painted in an inverted position on the retina. It has been supposed that Objects appear to the mind original- -ly as they are painted on the retina, but that we learn from habit to give them a just position, but this is an erroneous opinion, for men who have been couched for Cataracts which they had from infancy, see things as we do, with respect to position, the instant they receive their light. The inverted position

v that are made upon them all.
We see more distinctly with two
eyes than =

position is both natural & necessary, for as the Mind follows each ray in its course from the part of the retina w^h is stimulated by it, it places Objects in their true Order. The rays which strike the lower part of the eye lead the mind upwards and vice versa. — Eg:

It is equally curious that with two eyes & two retinas ~~two~~ two impressions made on each of them, we see but one Object. This too has been erroneously ascribed to habit. I explain it thus. From two impressions of equal force, we can have but one sensation. Even those insects which have eight eyes, have but One Sensation from all the impressions

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= with one. The right eye is chiefly employed in Vision. But in all as the apistance is which the eyes give to each Other, $\frac{1}{10}$ - to $\frac{1}{15}$ Vision is less true, espci= =ally with respect to Distance & Direction with one eye than with two. This is Obvious in persons with one eye when they attempt to Snuff a candle, or to pour wine into a glass. They generally mistake those Objects, Until time and habit have taught them better. ~~Vatricle~~ With respect to Acute= =ness & correctness of Vision, it is more perfect ~~than~~ with One eye, than with both, hence Watchmakers, and Astronomers look with One eye

this their respective glasses.

I have several times mentioned the Dependance of the Senses upon each Other. Vision owes much to the sense of touch. Without it we should be unable to distinguish distance, figure and motion. This has been proved by many experiments. The young man recently couched by Chesselden imagined every Object he saw touched his eyes. Other persons recently restored to their Sight (who had never seen before) have thought large Objects small, Square Objects round, and moving Objects, stationary. Philosophy therefore confirms the truth of the history of the Case of a man born blind

recorded in the new testament.
He saw, when his sight was restored,
men – not as they are – but as
trees, that is as unlike to men as
trees, for he had no doubt when
a ~~lad~~ boy often handled, & climb-
-ed trees, and had thereby formed
an obscure idea of their Dimensions
and height.

From what has been said we
are able to answer the following
questions.

Why do some Animals see to per-
-fection in the dark? I answer – be-
-cause they have a large dilatable
pupil, a shining Choroides, and an
exquisitely sensible retina.

Why do we feel pain when we are brought out of a Dark room into the meridian or a glaring light? — because the pupil having been greatly dilated, ~~and~~ is suddenly by exposed to too great a quantity of light which stimulates the retina so forcibly as to give pain.

Why do we lose our sight when suddenly brought from a strong to a weak light? because the retina is incapable of being moved by a weak stimulus after being exposed to a strong one.

Why is the eye rendered soft & dazzy is being by looking at black

and never to read by 295 excessive or scanty light — nor to read constantly one kind of print — nor Books printed on very white paper.

3 to avoid keeping the eye in washing the face. It tends to flatten the eyes & thereby to lessen light — by producing prematurely the disease of Presbyopes. 4 By blacking the eyelids, or by combing black hair low over the forehead; vision is improved. Those black matters absorb certain rays of the eye being overcharged with them. 5th By the early use of Spectacles, as soon as the sight begins to decay. 1 = 1 as below

= 5th Mr Rosse mentions an instance of the sight being improved by the practice of examining the flowers of plants in order to discover their relations to each other.

6 as above =

1 = 1 7 2 By reading or writing before day instead of after light. Lord Erskine and Mr Rawle. This eyes injured by reading by candle light after sight. X